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PUNCHING AND BINDING MACHINE

Cross Reference To Related Application

[0001] This application is a ***national stage*** of PCT/EP00/07220 filed July 27, 2000 and based upon DE 199 47 257.2 filed September 30, 1999 under the International Convention.

BACKGROUND OF THE INVENTION

Field of the invention

[0002] The invention concerns a punching and binding machine for a stack of sheets, comprising a punching mechanism which includes an insertion gap limited on one side by a punch matrix and preferably with adjustable depth and/or lateral limit stops for the sheets of the stack of sheets to be provided with a row of binding holes near one edge, and which includes a number of punch blades arranged in defined separation from each other along the insertion gap and moveable via an actuating mechanism perpendicularly through the insertion gap and the punch matrix, wherein preferably individual punch blades can be decoupled from the remaining punch blades as selectable blades, and with a binding mechanism for binding the stack of sheets by means of an elastic binder spine engaging through the binder holes, which binder mechanism includes two spreader bodies for spreading apart the binder spine, which are moveable relative to each other by means of second actuating mechanism and preferably limited in motion by an adjustable limit stop.

Description of the Related Art

[0003] Combined punching and binding machines of this type (EP-A-727327, EP-A-864441) include different adjusting mechanisms for the depth limit and the lateral limit stop of the punching mechanism and for the limiting of the spreader body of the binder mechanism, all of which are respectively manually operated separately from each other. The punching mechanism includes an operating lever, of which the rotational movement is converted into a translational movement of the punch blades. In order to produce different patterns of holes, individual punch blades provided on a blade carrier

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can be selectively disengaged by hand. Further included is a binding mechanism with two spreader bodies, which include a plurality of hook elements for engagement of the binder spine, and which spreader bodies can be spread apart from each other with the aid of an actuating mechanism formed as an operating lever, spreading apart the hooked in binder spine. In conformance with the size of the selected binder spine the width to which the spreader bodies are spread apart can be limited by a manually adjustable limit stop. It is considered to be a disadvantage with the known punching and binding devices that the many adjustments, which must be carried out prior to a punching and binding process, are time consuming and not verifiable and thus easily can lead to errors or defects.

SUMMARY OF THE INVENTION

[0004] Beginning herewith the present invention is concerned with the task of improving the above-described punching and binding machines according to the state of the art in such a manner, that the adjustment or set up process is simplified and the likelihood of errors or defects is substantially avoided.

[0005] The inventive solution is based upon the recognition that the different adjustments to be applied to the punching and binding machine, for any given selected sheet format and stack dimension, partially correspond with each other. In the application of this principle in accordance with the invention, multiple adjustment mechanisms are so coupled with each other that for each change in size of the material being punched and bound only a few, easily carried out adjustments are necessary.

[0006] In order to accomplish this, an adjustment means for simultaneous operation of an adjustment mechanism for the lateral limit stop and a coupling mechanism for the selectable blades is proposed in accordance with a first embodiment of the invention proposed. By means, it is possible to provide in a stack of sheets with a predetermined sheet size with a symmetric pattern of holes with reference to the upper or lower edge

and at the same time to ensure that with the format setting that no prohibited edge perforations result.

[0007] According to a preferred design of the invention the adjustment mechanism displays multiple setting positions, preferably defined by a scale and/or engagement or detent positions, with predetermined association of the lateral limit stop and the coupling/uncoupling condition of the selectable blades. The adjustment mechanism for the lateral limit stops thereby preferably exhibits a ram which is displaceable in the insertion gap in the longitudinal direction via the adjusting means and which carries on its end an abutment or limit stop element. The adjustment means, preferably in the form of a rotating knob, is preferably operably associated with a curve wheel, which exhibits an adjustment curve for receiving a sliding-block fixed to the ram. In order to make possible a supplemental adjustment or calibration of the lateral limit stop, which would be necessary for example in the case of use of over-sized cover pages or protective covers, the adjustment means in accordance with a further preferred embodiment of the invention exhibits a calibration means for the fine adjustment of the lateral limit stop in each adjustment position of the adjustment means. The fine adjustment can technically be accomplished thereby, that the curve wheel is connected fixed against rotation and axially slideably with the rotating knob, while the adjustment means is limitedly rotatable with respect to the rotating knob and engages with at least one slide-block in a preferably screw-shaped fine adjustment curve of the curve wheel. For improvement of the precision during the calibration process the curve wheel exhibits at least two, preferably three identical fine adjustment curves angularly separated from each other for receiving a corresponding number of slide-blocks provided on the adjustment means in angular separation from each other.

[0008] It is envisioned in accordance with a further advantageous embodiment of the invention that the coupling mechanism for the selectable blades comprises a camshaft coupled fixed against rotation with the rotating knob adjustment means, with one cam curve associated respectively with each of the selectable blades, as well as a locking

means radially adjustable via the associated cam curve. The punch blades, inclusive of the selectable blades, are therein preferably associated with a blade shaft concentric with the camshaft and exhibit a curved punch part radially spaced apart from the outer surface of the blade shaft and coaxial thereto, so that this is operated when initiating a punch process by the rotation of the blade shaft. Preferably the selectable blades and the blade shaft are axially not displaceable relative to each other and are rotatable relative to each other about the common axis of rotation. The locking means formed as a locking pin extends through a radial borehole in the blade shaft, wherein in the locking position the concerned cam curve urges the locking pin into an open radial borehole of the selectable blade and in the disengaged position the locking pin is forced out of the radial borehole of the selectable blade in the direction of the blade shaft and thereby frees the blade for relative rotation between the selectable blades and the blade shaft. The disengaged selectable blade is however taken along during rotation of the blade shaft under the influence of contact friction until abutment against the stack of sheets. During further rotation of the blade shaft the frictional engagement however does not suffice, due to lack of form-locking coupling, for the carrying out of a punching process. The locking means is urged in the direction of the camshaft by a spring, so that it is ensured in the disengaged position, that the locking means is completely forced out of the radial borehole of the selectable blades.

[0009] The operation of the blade shaft can either occur by hand using an actuating lever connected fixed against rotation therewith or using and electric motor controlled by a switch.

[00010] In accordance with a further advantageous or alternative embodiment of the invention a measurement means is provided for determining the thickness of the stack of sheets to be processed, which is coupled with a device for adjusting the boundary limit stop of the binder mechanism and/or a device for adjusting the depth limit stop in the insertion gap of the punch mechanism and/or with a device for

displaying the selectable binder spine size according to the measured dimensions of the thickness of the stack of sheets.

[00011] Preferably the measuring device includes a measuring chamber for receiving the stack of sheets to be processed as well as a measuring device which engages in the measuring chamber, which measuring means is coupled with the adjustment device for the boundary limit stop and/or the depth limit stop and/or with the display device for the binder spine size.

[00012] Preferably the measuring chamber includes a floor for establishing or setting up one of the edges as well as a abutment surface (back wall) oriented perpendicularly upwards from the floor for the backward facing broadside of the stack of sheets, while the measuring means includes an arm which abuts or contacts the stack of sheets against the front broadside. It has been found to be particularly advantageous when the measuring means is rotatable about an axis parallel to the surface upon which the stack of sheets is laid and engages with its arm in the measuring chamber.

[00013] According to a further advantageous embodiment of the invention it is envisioned that one of the two spreader bodies is displaceable with an operating means in the form of a slider relative to the other spreader body to the boundary limit stop. Thereby one of the two spreader bodies can exhibit straight and the other angularly bent spreader elements. It has been found to be advantageous when the spreader body with the straight spreader elements is displaceable and the other spreader body is fixed.

[00014] Depending upon the selection of the binder spine size, more or less thick stacks of sheets can be bound using the binder mechanism. With the present punching mechanism however only a limited number of sheets can be punched. When binding thick stacks of sheets it is thus necessary to extract more slender stacks of

sheets for punching and after the punching to assemble them in the binder mechanism. In order to facilitate the extraction of suitable stack segments, it is envisioned in accordance with a preferred or alternative embodiment of the invention that a measuring chamber or a sheet stack magazine is provided for receiving respectively one of the stacks of sheets to be bound, with a floor for setting up one of the stacked edges as well as a perpendicular to the floor and upwardly directed contact surface for one of the broadside surfaces or the stack of sheets, wherein the floor exhibits graduated steps relative to the contact surface. The breadth of the steps is selected to be smaller than the width of the insertion gap of the punching mechanism. By this means it is achieved, that partial stacks of suitable thickness project stepwise over the measuring chamber or the magazine stack, so that they can be sequentially picked up or extracted, introduced into the punching mechanism and then laid into the binder mechanism.

BRIEF DESCRIPTION OF THE DRAWING

[00015] In the following the invention will be described in greater detail on the basis of the illustrative embodiments shown in the figures. There is shown

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| Fig. 1a and b | a perspective representation of a combined punching and binding machine in opened and closed positions; |
| Fig. 2a | a perspective representation of the binding machine according to Fig. 1a and b with removed adjustment wheel for the formatting adjustment; |
| Fig. 2b and c | a longitudinal section through the punching and binding machine according to Fig. 2a in perspective representation with and without blade shaft; |

- Fig. 2d a longitudinal section through the punching and binding machine according to Fig. 2a;
- Fig. 3a a perspective exploded representation of the adjustment mechanism for the lateral limit stop with camshaft for the selectable blades;
- Fig. 3b a side view of the adjustment mechanism according to Fig. 3a in assembled condition in partial sectional representation;
- Fig. 4a a perspective exploded representation of the blade shaft with punch blades and camshaft for the control of the selectable blades;
- Fig. 4b a perspective view of the blade shaft in assembled condition;
- Fig. 5a a side face view of the blade shaft with camshaft and selectable blades;
- Fig. 5b and c a section through the blade shaft with coupled and decoupled selectable blades;
- Fig. 6 a perspective representation of the measurement means for the determination of the thickness of the stack and the therewith coupled adjustment mechanism for setting the depth in the insertion gap and for the adjustment of the boundary limit stops for the binder mechanism.

DETAILED DESCRIPTION OF THE INVENTION

[00016] The punching and binding machine shown in the figures is designed for the punching and binding of stacks of sheets of various thickness and with various

sheet sizes. The punching and binding machine includes a punch mechanism **10** with an insertion gap **12** for sheets **14** to be provided with a row of binder holes along an edge, a binder mechanism **16** for binding the stack of sheets in the area of their binder holes by means of a not shown elastically spreadable binder spine, a sheet magazine **20** with measuring chamber **22** pivotable with respect to the machine housing **18** between a work position (Fig. 1a) and a rest position (Fig. 1b), and a measuring means **24** engaging in the measuring chamber of the sheet magazine **20** for measuring the thickness of the stack of sheets (not shown) introduced in the measuring chamber. Further provided is a device **26** for the adjustment or selection of the format, an operating lever **30** coupled with the blade shaft **28** for the operation of the punch blades **46**, **56** provided on the blade shaft of the punch mechanism **10** and an actuating means **34** formed as a ram or pusher for the spreading apart relative to each other of the spreader bodies **36**, **38** forming the binder mechanism **16**.

[00017] As can be seen from Figs. 2d and 4b, the blade shaft has, on its end **40** coupleable with the operating lever **30**, over a part of the length of the blade shaft, radially projecting receiving ribs **42** for the punch bodies **44**. The punch bodies **44** exhibit multiple punch blades **46** arranged in axial separation from each other and projecting in the circumference direction over the receiving ribs **42**, which punch blade **46** are provided on their front surfaces with a punch cutting edge **48**. In the assembled condition the punch bodies **44** with the punch blades **46** are curved coaxial to the axis **50** of the blade shaft **28**. The individual punch blades **46** of the punch body **44** are of different length in the circumference direction so that they come into effect at different angular positions of the operating lever during the punch process. Thereby the punch forces to be overcome are staggered and reduced. The punch bodies **44** are fixed against displacement in the circumference direction and in the axial direction using pins – not shown - in the boreholes **52** of the receiving ribs **42**. In the shown embodiment three selectable blades **54** are additionally provided upon the blade shaft **28**, situated in different axial positions, which exhibit curved punch blades **56** projecting in the

circumference direction and which are form-lockingly coupleable with the blade shaft **28** selectively via a camshaft **58**.

[00018] The insertion gap **12** is bordered, on the side opposite to the cutting edges **48** of the punch blades **46** and **56**, by a punch matrix **60**, which exhibits through-holes **62** for the punch blades **46**, **56** equally spaced apart from each other and which communicate, on their side opposite to the insertion gap **12**, in a receiving container **64** for the punched-out residue. During the punch process the operating lever **30** is pivoted from an upwardly directed starting position into the end position shown in Fig. 1a. Thereby the punch blades **46**, **56** enter with their cutting edges **48** sequentially into the insertion gap **12** and the through hole **62** of the punch matrix **60** and produce in this manner the binder holes along the edge of the sheets **14** situated in the insertion gap.

[00019] In order to correctly position the binder holes along the edge of the sheets **14**, various adjustments or settings need to be undertaken prior to the punching process. For this there is used, on the one hand, the device **26** for the selection of the sheet format and, on the other hand, the measuring device **24** for determining the thickness of the stack and for adjustment of the setting parameters dependent therefrom.

[00020] With the aid of the device **26** for the setting up of the format there is adjusted within the insertion gap **12** the limit stop **66** for the sheets **14** to be punched. Besides this, thereby the selectable blades **54** are engaged or disengaged depending upon the dimensions of the predetermined format. Therewith a symmetric arrangement of holes is provided along the punched edge and at the same time it is avoided that the side edges are punched through. The lateral limit stop **66** is situated on one end of the ram **68**, which on its other end engages via a slide-block **70** into an adjustment curve **72** of the curve wheel **74**. The curve wheel **74** is mounted fixed against rotation and axially displaceable on a rotation knob **76**, which for its part is mounted, fixed against axial displacement, in a rotation mount of the machine housing **18**. On the rotation

knob there is additionally mounted a fine adjustment knob **78** fixed against axial displacement. This engages with three arms **80**, provided in equal angular separation from each other, through arc-shaped slits **82** in the rotation knob **76**. On the free ends of the arms **80** there are slide-blocks **84**, which engage in three, angularly spaced apart from each other, identically screw shaped adjustment curves **86** of the curve wheel **74**. Therewith via the fine adjustment knob **78** the curve wheel **74** and therewith the lateral limit stop **66** can be slid or displaced relative to the rotation knob **76** and the insertion gap **12**.

[00021] Further a camshaft **58** is connected, fixed against rotation and axial displacement, with the rotation knob **76**. The camshaft **58** engages in a central borehole **90** of the blade shaft **28** open towards the side of the rotation knob **76**, and exhibits one cam curve **92** rotatable about the axis **50** at the respective axial positions of the selectable blades **54** provided on the blade shaft **28**. As can be seen from Fig. 5a through c, a radial blocking pin **96** is positioned in a radial through hole **94** of the blade shaft **28** via the cam curve **92** of the camshaft **58**. The locking pin **96** is urged against the cam curve **92** by a spring **98** supported in the selectable blade **54**. Depending upon the rotation position of the respective cam curve **92** the locking pin **96** engages in one open blind hole **100** of the blade shaft **28**, or is withdrawn therefrom. In the engagement position of the locking pin there is produced a form-locking connection of the concerned selectable blade **54** with the blade shaft **28**, while in the extracted or disengaged position there is a loss of form locking and the selectable blade **54** is rotatable in a circumference groove **102** of the blade shaft **28** coaxial to the axis **50**.

[00022] The rotation knob **76** exhibits on its circumference a scale **103**, via which the sheet size can be input or setup. By this adjustment, simultaneously the lateral limit stop **66** is input and the associated selectable blades **54** are selected. In order to take into consideration deviations from standard formats, for example in the case of a cover page for the stack of sheets to be bound, the fine adjustment knob **78** can be used for

adjusting the lateral limit stop **66** without changing the settings of the selectable blades **54**.

[00023] The thickness of the stack of sheets can be determined using the measuring means **24**. For this purpose the stack of sheets is inserted into the measuring chamber **22** of the sheet magazine **20** and with its backward facing broad side surface is brought against the wall **106** projecting from the floor **104** of the measuring chamber **22** perpendicularly upwards. The measuring device **24** includes a rotation knob **108** and/or a lever **110**, which engage into the inside of the measuring chamber **22** via an arm **111**. By adjusting the rotation knob **108** with a lever **110** the arm strikes against the front broad side of the stack of sheets. Thereby there results from the rotation position of the rotation knob **108** or the lever **110** a measurement for the thickness of the stack sheets. The rotation position of the rotation knob **108** or the lever **110** is also used for positioning a depth limit stop **112** within the insertion gap **12** as well as a breadth limit stop **114** for the operating means **34**. As the stack of sheets to be bound is increasingly thick, so the breadth of the hole edge to be selected must be increasingly broad. This occurs using a depth limit stop **112**. Besides this, for different thicknesses of sheet stacks there are to be selected in stages binder spines of different sizes, so that the spreader body **36**, **38** of the binder mechanism **16** must be spread apart to different degrees. This occurs by the automatic adjustment of the breadth limit stop **114**. Besides this, in a display **116** the binder spine size associated with a measured stack thickness is indicated. Instead of measuring the thickness, the size of the binder spine can be selected using the the display **116** on the rotation knob **108** or the lever **110** and via this size selection the depth limit stop **112** and the boundary limit stop **114** can be adjusted.

[00024] As can be seen from Fig. 2b through d, the floor **104** of the measuring chamber **22** exhibits a number of steps **118**, which descend towards the back wall **106**. By this arrangement of steps it is possible to subdivide a thick stack of sheets in such a manner that the partial stacks are easily picked up along their upper edge steps. The

steps **118** are thereby so selected, that the individual partial stacks (or upper edge steps) fit in the insertion gap **12**. Thereby the punching and binding of thick sheet stacks, which could not be punched all at once, is facilitated.

[00025] In summary the following can be concluded: The invention relates to a punching and binding machine for stacks of sheets. The machine comprises a punching mechanism **10** which has an insertion gap **12** with adjustable low and lateral stops **112**, **66** for the sheets to be punched as well a number of punching blades **45**, **56**. Individual punching blades **56** are part of the selectable blade **54** which can be decoupled from the remaining punching blades. The inventive machine is also provided with a binding mechanism **16** for binding the stack of sheets by using an elastically expandable binding back or spine. In order to simplify the operability of the machine, a setting element is provided for simultaneously actuating an adjusting mechanism for the lateral stop **66**, and a coupling mechanism is provided for the selectable blade **54**. In addition, a measuring device **24** is provided for determining the thickness of the stack of sheets to be found, and a device which is coupled to said measuring device is provided for adjusting the delimiting stop for the binding mechanism **16** as well as for adjusting the depth stop **112** in the insertion gap for the punching mechanism **10** in accordance with the measured thickness of the stack of sheets.